6. GENERAL POPULATION EXPOSURE AND RISK SCREENING ANALYSIS

This chapter examines risks to the general population from exposure to ambient air releases of substitutes for ozone-depleting propellants and solvents in the aerosols sector.   This analysis is based on a screening-level approach that incorporates conservative assumptions to provide high-end to upper bound estimates of exposure and risk.

This chapter is divided into five sections.   Section 6.1 presents the approach used to calculate general population risks, and Section 6.2 presents the results of the calculations.   Section 6.3 presents an assessment of potential concern for human health risks.   Caveats and limitations of the analysis are discussed in Section 6.4, and the conclusions are summarized in Section 6.5.[1]

6.1   APPROACH

The basic approach used in this screening analysis was to (1) develop conservative estimates of annual releases of substitutes to ambient air from aerosol manufacturing sites and from industrial sites using aerosols; (2) use generic dispersion factors to calculate concentrations of the substitutes in air near the release site; and (3) compare these concentrations to health-based reference concentrations (RfCs) and, for carcinogens, calculate cancer risk.

Estimating Releases

Aerosol manufacturing facilities are aerosol can-filling operations.   Releases from these sites come from the filling and storage of aerosol cans.   Annual releases of ozone-depleting propellants and solvents from aerosol manufacturing facilities were estimated based primarily on information from prior Agency publications on the use of ODSs in aerosol products, and on interviews with aerosol product manufacturers.   The rate of filling of aerosol units, the number of shifts per day, the size of aerosol units, the percent of ODS per unit, and the percent loss during manufacturing were taken into account in formulating the high-end release scenario.   The assumptions and calculations for estimating releases from both propellant and solvent aerosol manufacturing sites can be found in Attachment 6-A.

Releases from industrial sites using aerosols were based on upper bound releases of ODSs reported in the Toxic Release Inventory (TRI).   Industrial emissions of solvents used in the aerosols sector were assumed to be the greatest from facilities using mold release agents.   These companies were identified by cross-referencing companies with SIC 3089 (plastic products) with those companies using CFC-113 as a manufacturing aide.   The largest release of CFC-113 reported in the TRI was identified as the upper bound industrial release.

Emissions of propellants from industrial facilities were not calculated but are likely to be lower than emissions of propellants from can-filling operations.

Releases of solvent substitutes from both manufacturing and industrial use sites were estimated assuming a one-to-one conversion between CFC-113 and the substitute.   The estimated releases are shown in Exhibit 6-1 and are used again in Chapter 7.

---

[1] Reference concentrations (RfCs) given in this chapter are considered Agency-verified unless otherwise noted.

EXHIBIT 6-1:
ESTIMATED ANNUAL PER-SITE RELEASES OF PROPELLANTS AND SOLVENTS IN THE PRODUCTION AND USE OF AEROSOLS

Aerosol Application	Manufacturing Releases (kg/yr)	Industrial Use Releases (kg/yr)
Propellant	144,000	N/C
Solvent	2,800	58,600

N/C = Not calculated.   Assumed to be lower than manufacturing releases of propellants (see text).

Estimating Downwind Concentrations

To estimate downwind concentrations near the site of release (i.e., at the "fenceline"), EPA first converted the annual releases shown in Exhibit 6-1 to grams per second (g/sec), and then multiplied each release by a "normalized concentration" to calculate a fenceline concentration in ug/m^3.   "Normalized concentrations" for different types of release sites were developed by EPA using the Industrial Source Complex Long Term (ISCLT) dispersion model.   EPA used professional judgment to determine which factors to apply to each type of site.   This approach is discussed in more detail in Attachment 6-B.

Calculating Human Health Risks

To screen potential noncancer risks to humans exposed to the modeled fenceline concentrations, EPA compared the modeled concentrations to reference concentrations for each chemical.   For petroleum-based hydrocarbons and oxygenated hydrocarbons, EPA selected two chemicals, one to represent each group.   The representative chemicals were chosen from a list of chemicals currently being used in aerosol applications and believed to be the most toxic of the chemicals in each group.   These representative chemicals provide conservative benchmarks for comparison.

Lifetime cancer risks were calculated for carcinogenic substitutes using EPA's standard risk equation.   The lifetime average daily dose of each substitute was estimated using the modeled exposure concentration (i.e., fenceline concentration), a 20 m^3/day inhalation rate, and a 70 kg body weight.   An exposure duration of 70 years, typically used in the calculation of lifetime exposure, was used in the estimation of cancer risk of chlorinated solvents.   However, EPA made a simple adjustment in the cancer risk analysis for HCFC-22 to account for the phaseout of HCFCs.   Because HCFC-22, a long-lived HCFC, will be phased out of new equipment production by 2010, a person living downwind of a facility producing products containing HCFC-22 would be exposed to HCFC-22 for only 18 years (1992 to 2010), and not the full 70 years used in the standard cancer risk equation.[2]   Thus, a correcting factor of $18/70^{ths}$ was used to calculate cancer risks for HCFC-22 from these sources.

The reference concentrations and cancer potency factors used for the risk calculations are presented in Section 6.2.   EPA's approach for identifying or deriving these values is discussed in Chapter 3.

6.2   RESULTS

---

[2]   The use of HCFCs in aerosols was restricted by EPA effective January 1, 1994.

Estimated fenceline concentrations of propellants and solvents near aerosol manufacturing and industrial use sites are presented in Exhibit 6-2. These exposure concentrations were calculated by multiplying the releases shown in Exhibit 6-1 (converted to grams per second) by the normalized concentrations identified in Attachment 6-B.

EXHIBIT 6-2: CALCULATION OF FENCELINE CONCENTRATIONS

Aerosol Use and Type of Site	Release (g/sec)	Normalized Concentration (ug/m^3)	Fenceline Concentration (ug/m^3)
Propellants			
Manufacturing Site	4.56	166.3	758
Industrial Site	N/C	--	N/C
Solvents			
Manufacturing Site	0.09	166.3	15
Industrial Use Site	1.86	472.7	879

N/C - not calculated

Noncancer Risk

For each noncarcinogenic chemical (or representative chemical), Exhibit 6-3 shows the predicted fenceline concentration, the RfC, and the ratio of fenceline concentration to the RfC. (The RfCs were identified or derived for the purposes of this risk screen using the methods discussed in Chapter 3.)

The predicted exposure concentrations of both the propellant and solvent substitutes near the aerosol manufacturing sites are below the respective RfCs. The estimated concentration of the aerosol solvent at the fenceline of an industrial use site (0.88 mg/m^3) is below the RfCs for all substitutes except n-hexane, the representative chemical for petroleum-based hydrocarbons. The predicted fenceline concentration for n-hexane exceeds its RfC by a factor of 4.4. The significance of this finding is discussed in Section 6.4.

Cancer Risk

Exhibit 6-4 shows the predicted exposure concentrations, cancer slope factors, and calculated cancer risk for carcinogens. The estimated cancer risk from exposure to HCFC-22 propellants released from an aerosol manufacturing site is 1.1×10^{-5}. Cancer risks from manufacturing aerosols containing chlorinated solvents are in the 10^{-5} risk range. Estimated cancer risks from exposure to chlorinated solvents released from industrial facilities that use

6-4

EXHIBIT 6-3: PREDICTED EXPOSURE CONCENTRATIONS AND RATIO TO REFERENCE CONCENTRATIONS FOR NONCARCINOGENS

Substitute	Exp. Conc. (mg/m^3)	RfC (mg/m^3)[a]	Ratio
PROPELLANTS: Manufacturing Site			
HCFCs HCFC-142b	.76	50	1.5×10^{-2}

Hydrofluorocarbons
    HFC-125
    HFC-134a
    HFC-152a
	.76
	.76
	.76
		10
		10
		40
			7.6×10^{-2}
			7.6×10^{-2}
			1.9×10^{-2}

Hydrocarbons
    n-Butane
    Isobutane
	.76
	.76
		.95
		.95
			8.0×10^{-1}
			8.0×10^{-1}

SOLVENTS: Manufacturing Site			
HCFCs HCFC-141b	.015	100	1.5×10^{-4}
Petroleum-based hydrocarbons n-Hexane[b]	.015	.20	7.5×10^{-2}
Oxygenated hydrocarbons Acetone[b]	.015	1	1.5×10^{-2}
Terpenes	.015	6	2.5×10^{-3}
SOLVENTS: Industrial Use Site			
HCFCs HCFC-141b	.88	100	8.8×10^{-3}
Petroleum-based hydrocarbons n-Hexane[b]	.88	.20	4.4
Oxygenated hydrocarbons Acetone[b]	.88	1	8.8×10^{-1}
Terpenes	.88	6	1.5×10^{-1}

[a] Some of the RfCs are Agency-verified while others are not. See Exhibit 3-1 for further information.
[b] These chemicals were chosen to represent this substitute category.

EXHIBIT 6-4: PREDICTED EXPOSURE CONCENTRATIONS, CANCER SLOPE FACTORS, AND CALCULATED CANCER RISK FOR CARCINOGENS

Substitute	Exposure Conc. (mg/m^3)	Slope Factor (mg/kg-day)$^{-1}$	Cancer Risk
PROPELLANTS: Manufacturing Site			
HCFC-22	0.76	2.0×10^{-4}	1.1×10^{-5}
SOLVENTS: Manufacturing Site			
Methylene Chloride	0.015	7.5×10^{-3}	3.2×10^{-5}
Trichloroethylene	0.015	1.7×10^{-2}	7.3×10^{-5}
Perchloroethylene	0.015	3.3×10^{-3}	1.4×10^{-5}
SOLVENTS: Industrial Use Site			
Methylene Chloride	0.88	7.5×10^{-3}	1.9×10^{-3}
Trichloroethylene	0.88	1.7×10^{-2}	4.3×10^{-3}
Perchloroethylene	0.88	3.3×10^{-3}	8.3×10^{-4}

aerosols are higher: 1.9×10^{-3} for methylene chloride, 4.3×10^{-3} for TCE, and 8.3×10^{-4} for PCE. The significance of these findings is discussed in the next section.

6.3   ASSESSING CONCERN FOR HUMAN HEALTH RISK

The results of EPA's screening analysis indicate that further assessment is needed to determine whether there is concern for the industrial use of aerosols containing petroleum-based hydrocarbons and chlorinated solvents as substitutes for solvents in aerosols. This section provides a more thorough discussion of the assumptions used in this analysis to assess whether the results are representative of exposures that are likely to occur and therefore indicative of potential health risks.

Estimating releases. The releases estimated for solvents are based on upper bound scenarios that may overstate releases. Several factors suggest that releases are declining and will continue to decline in the future.

• The upper-bound scenario for releases of aerosol solvents to air was based on sources reporting the maximum emissions of CFC-113 in the Toxic Release Inventory (TRI) in 1989. However, as TRI may include emissions from non-aerosol sources, this approach may overestimate aerosol solvent releases from industrial use sites.

• EPA plans to issue regulations to control air toxic emissions from aerosol can-filling operations by November 1997. These regulations are likely to reduce manufacturing site releases of hazardous air pollutants (e.g., chlorinated solvents). In addition, EPA plans to promulgate regulations to control the emissions of air toxics from industrial facilities that use surface coating processes, which may include some industrial uses of aerosol products, on a schedule that will begin in November 1994.

• All of theses substitutes, with the exception of methylene chloride, are VOCs. Manufacturers and industrial users switching to these substitutes may need to install emission recovery devices to comply with VOC restrictions.

• Compliance with OSHA PELs for the substitutes will further reduce workplace, and therefore ambient, emissions (see Chapter 5).

• Current and future emissions of substitutes for these controlled substances are likely to be lower because emissions of aerosol solvents from these particular sources and the sector in general are declining. Users are switching to alternatives such as water-based formulations and alternative cleaning methods which result in lower or no releases to the air. Large users are likely to take measures to reduce emissions of substitutes as they become more aware that substitutes may present hazards to human health and the environment, and that they may cost more than the controlled substances they are replacing.

Estimating downwind concentrations. The modeling approach used by the Agency is thought to provide conservative estimates of fenceline concentrations.

Screening potential risks. Risks for petroleum-based hydrocarbons were estimated based on the chemical believed to be the most toxic among the substitutes identified. Also, cancer risk calculations assume that an exposed individual lives and works in the same zone of concentration 24 hours per day, year-round, throughout a 70-year period.

While it is not possible to quantify the collective effect of all of these factors on estimated human health risk, EPA believes that theses factors would reduce or eliminate potential concerns raised by the analysis for noncancer risks. It is uncertain whether these factors would mitigate concern for cancer risks associated with chlorinated solvents.

6.4   ADDITIONAL CAVEATS AND LIMITATIONS

The assessment of risks to the general population is a simple screening analysis that incorporates a variety of simplifying assumptions, The approach was intended to yield exposure estimates that are conservative, i.e., that overestimate true risk. This section lists two additional limitations to the analysis that were not listed above.

Estimating Releases. Manufacturers are not always at peak production levels as this analysis assumes, and filling technologies are likely to reduce fugitive emissions relative to those used in this analysis. In formulating an upper bound release scenario for aerosol propellant filling operations, it was assumed that a filling facility operates year round at peak production levels. In actuality, production levels fluctuate in response to demands for product. These fluctuations in production reduce yearly emissions compared to the upper bound scenario. In addition, filling technologies have become far more efficient and less wasteful in recent years. Such technologies have reduced the percent of fugitive-losses, far below the 8 percent figure used in the analysis (see Attachment 6-A).

Estimating downwind concentrations. The ISCLT model runs performed by EPA to calculate normalized concentrations did not cover aerosol manufacturing or use sites. EPA used professional judgment to determine which sources were closest to aerosol manufacturing/use sites. This issue is discussed in more detail in Attachment 6-B. Uncertainties associated with EPA's derivation of the normalized concentrations include the following[3]:

---

[3] See U.S. EPA. 1990. November 7. *Potential Ambient Inhalation Exposures for Chlorofluorocarbon Substitutes*. U.S. EPA Office of Toxic Substances, Exposure Evaluation Division, Exposure Assessment Branch.

• EPA used a generic site location to model downwind concentrations. The meteorological conditions at this generic site were known to cause conservative estimates of downwind concentrations.

• Facility fenceline distance estimates were also assumed by EPA. For some types of release sites, the model could not estimate concentrations at the assumed fenceline distance. In these cases, the modeled concentrations at the exposure point could be underestimates.

6.5   SUMMARY

Predicted concentrations of propellant substitutes in air at the fenceline were below health-based reference concentrations. Because the approach used in this analysis was intended to yield conservative estimates of risk, noncancer health risks associated with these substitutes are not of concern. Cancer risk associated with the use of HCFC-22 was estimated to be 1.1×10^{-5} and is of low concern.

With the exception of n-hexane, predicted solvent exposure concentrations do not exceed reference concentrations for any solvent substitute examined in this screening analysis. Given that EPA used conservative assumptions, predicted risk is likely to be overestimated. In addition, VOC regulations, OSHA standards for occupational exposure, and other factors are likely to reduce or eliminate any concerns for noncancer risk associated with n-hexane.

The results of the risk screen for cancer risk from the use of chlorinated solvents suggest that the use of these substitutes poses a potential concern for cancer risk. Again, because of the conservative nature of this screening analysis, it is likely that the risks are overstated. Also, future air toxics regulations may mitigate potential risks associated with the hazardous air pollutants.

CHAPTER 6 REFERENCES

Amway.   1992.   March 11.   Ted Joppie, ADA, MI. Telephone Conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Blue Coral Inc. (Westley).   1992.   March 11. Richard Pearl, Cleveland, OH. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Blue Coral Inc. (Westley).   1992.   March 19.   Richard Pearl, Cleveland, OH. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Chem Tech.   1992.   March 19.   Carl Saake, St. Louis, MO. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

CRC Chemical.   1992.   March 11.   John Fischer, Warminster, PA. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Dow Chemical.   1992.   March 9.   Jim Mertens, MI. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Dupont. 1992.   March 19.   John Leuszler, Morristown, NJ. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Dupont.   1992.   March 25.   John Leuszler, Morristown, NJ. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Falcon Safety Poducts.   1992.   March 19.   Phil Labin, Sommerville, NJ. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Garden, Carton and Douglas.   1992.   March 19.   Mathuew Palche, Washington, D.C. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Kiwi Brand Inc. 1992.   March 19.   Peter Burke, Douglasville, PA. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Midas Brakes.   1992.   March 10.   Rick Reuch, Washington, D.C. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Miller Stevenson.   1992.   March 19.   Bill Brennen, Danbury, CT. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Percy Harms Co.   1992.   March 10.   Lisa Kasper, Wheeling, IL. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Price-Driscol.   1992.   March 19. Phil Barth, Farmingdale, NY. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Price-Driscol.   1992.   March 25.   Jeff Otto, Farmingdale, NY. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Radiator Specialty.   1992.   March 11.   Guy Snow, Charlotte, N.C. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Radiator Specialty.   1992.   March 19.   Guy Snow, Charlotte, NC. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Safety Kleen.   1992.   March 11.   John Kusz, Elgin, IL. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Spontex Co.   1992.   March 10.   Bob Beuerlein, Columbia, Tenn. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Sprayon.   1992.   March 10.   Carol Crizan, Anaheim, CA. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Sprayon.   1992.   March 26.   Richard Miller, Anaheim, CA. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

Tech Spray.   1992.   March 19.   Bruce Riffel, Amarillo, TX. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

UNEP.   1991.   December.   *Aerosol Products, Sterilants, Miscellaneous Uses and Carbon Tetrachloride, Technical Options Committee*.   United Nations Environmental Programme, Pursuant to Article Six of the Montreal Protocol.

Unocal.   1992.   March 20.   Bob Heinrichts, Schaumburg, IL. Telephone conversation with Joseph Baron, ICF Incorporated, Washington, D.C.

U.S. EPA. 1992.   *Draft Background Document On Identification of Nonessential Products That Release Class I Substances.*   Office of Air and Radiation, Global Change Division.   November 1992.

U.S. EPA.   1991.   *Banning Nonessential Products That Release Class I or Class II Substances*.   The Nonessential Products Subcommittee, Stratospheric Ozone Protection Advisory Committee.   April, 1991.

U.S. EPA. 1989.   *Alternative Formulations To Reduce CFC Use in U.S. Exempted and Excluded Aerosol Products*.   Office of Air and Radiation, Research Triangle Park NC.   November, 1989.

U.S. EPA. 1989.   *Aerosol Industry Success In Reducing CFC Propellant Usage*.   Office of Air and Radiation, Air and Energy Engineering Research Laboratory, Research Triangle Park NC.   November, 1989.

U.S. EPA.   1989.   February.   *Use and Substitutes Analysis of Methyl Chloroform (1,1,1-Trichloroethane)*.   Office of Air and Radiation, Global Change Division.   February, 1989.

U.S. EPA. 1988.   *Use and Substitutes Analysis of Chlorinated Solvents in Aerosols*.   Office of Pesticides and Toxic Substances, Regulatory Impact Branch.   April, 1988.

ATTACHMENT 6-A
ESTIMATES OF RELEASES FROM AEROSOL MANUFACTURING FACILITIES

This attachment discusses EPA's approach for developing release scenarios to estimate emissions of aerosol propellants and solvents from hypothetical facilities that fill aerosol cans.   This approach provides conservative or "high-end" estimates of releases from can-filling operations.

To calculate these releases, EPA estimated the number of aerosol cans filled annually at a single, large manufacturing facility; the quantity of ODSs placed in each can; and the proportion of ODSs that escape to the atmosphere.

EPA's estimate of the number of aerosol units filled annually were based on the following assumptions, which are considered realistic for a large site:

Rate of production of aerosol units:	28,000 units per shift
Number of shifts per day:	1 shift per day
Number of operating days:	250 days per year

Because differences exist in the nature of propellant and solvent aerosol can-filling operations, assumptions concerning emissions of ODSs differ.   The total mass of substance within the aerosol can is assumed to be 0.32 kg for both, but the percentage of the mass that is ODSs is assumed to be 74 percent for propellants and 48 percent for solvents.   The fugitive releases associated with the filling of an aerosol can is estimated at 8 percent for propellants and 0.26 percent for solvents.   These assumptions are based primarily on several Agency publications and telephone interviews with industry representatives.

Based on this approach and the assumptions outlined above, the calculated releases from the filling of aerosol cans and pressurized dispensers are 144,140 kg of ODSs per year for propellants and 2,800 kg of ODSs per year for solvents.

Propellant Releases

- Annual production of aerosol cans from a single manufacturing facility:

    (cans per shift)*(shifts per day)*(days per year)

    (28,000 cans/shift)*(1 shift/day)*(250 days/year)

    =   **7,000,000 cans/year**

- Annual quantity of ODSs used to fill these cans:

    (total cans per year)*(average mass per can)*(% of mass that is ODSs)

    (7,000,000 cans/year)*(0.32 kg/can)*(74% ODS)

    =   **1,657,600 kg of ODSs per year**

- Annual quantity of ODSs liberated:

    (kg ODSs used per year)*(% liberated/% canned)

    (1,657,600 kg ODSs/year)*(0.08 liberated/0.92 canned)

    =   **144,140 kg of ODSs released per year in model plant**

Solvent Releases

- Annual production of aerosol cans from a single manufacturing facility:

    (cans per shift)*(shifts per day)*(days per year)

    (28,000 cans/shift)*(1 shift/day)*(250 days/year)

    =   **7,000,000 cans/year**

- Annual quantity of ODSs used to fill these cans:

    (total cans per year)*(average mass per can)*(% of mass that is ODSs)

    (7,000,000 cans/year)*(.32 kg/can)*(48% ODS)

    =   **1,075,200 kg of ODSs per year**

- Annual quantity of ODSs liberated:

    (Kg ODSs used per year)*(% liberated/% canned)

    (1,075,200 kg ODSs/year)*(0.0026 liberated/0.9974 canned)

    = **2,800 kg of ODSs released per year in model plant**

ATTACHMENT 6-A REFERENCES

Terco.   1992.   September, 14.   David Cull, Schamburg, Il.   Telephone Conversation with Joseph Baron, ICF Incorporated, Washington, DC.

U.S. EPA.   1991.   *Manual for Non-CFC Aerosol Packaging: Conversion Form CFC to Hydrocarbon Propellants.*   Office of Air and Radiation, Research Triangle Park, N.C.   September, 1991.

U.S. EPA.   1989.   *Alternative Formulations To Reduce CFC Use in U.S. Exempted and Excluded Aerosol Products.*   Office of Air and Radiation, Research Triangle Park, N.C.   November, 1989.

ATTACHMENT 6-B

METHODOLOGY FOR ESTIMATING GENERAL POPULATION EXPOSURES TO AMBIENT AIR RELEASES OF SUBSTITUTES FOR OZONE-DEPLETING SUBSTANCES FOR SNAP RISK SCREENS

The approach used to estimate general population exposures to ambient air releases of substitutes for currently used ozone-depleting substances (ODSs) for the SNAP risk screens is patterned after the approach EPA used previously (EPA 1990a) for the interim report on HFCs and HCFCs (EPA 1990b). The sections below summarize EPA's earlier approach and discuss how it was applied to the SNAP risk screens.

SUMMARY OF EPA'S EARLIER APPROACH FOR ESTIMATING GENERAL POPULATION EXPOSURES

EPA's approach for estimating general population exposures for the interim report on HFCs and HCFCs is summarized in the two documents referred to above.   EPA used information developed by PEI (EPA 1990c), combined with engineering judgment, to develop estimates of ambient air releases from each of the activities shown in Exhibit 6-A-1.   EPA then used the Industrial Source Complex Long Term (ISCLT) Dispersion Model to estimate ambient air concentrations at an assumed exposure point.

The ISCLT model is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial source complex.   Additional information on the model can be found in EPA's *Industrial Source Complex (ISC) Dispersion Model User's Guide* (EPA 1986) and addendum (EPA 1987).   The model has not been through Science Advisory Board or formal external peer review, but it has been reviewed and recommended for general use by EPA's Office of Air Quality Planning and Standards for applications similar to this.

To run the ISCLT model, it was necessary for EPA to develop inputs for source characteristics and meteorological factors.

- EPA used engineering judgment to develop assumptions about the characteristics of the facilities (e.g., stack height, surface area) from which the ODSs are released.

- EPA used meteorological conditions for a "generic" site, which was selected based on an analysis of maximum exposed individual concentrations calculated for an identical release from each of 392 sites across the U.S.   The meteorological conditions at this generic site were known to cause conservative estimates of exposure point concentrations.

EPA then used the ISCLT model outputs to estimate concentrations at the fenceline of the release site. Distances to the fenceline varied depending on the type of release site, and were based on professional judgment.   EPA points out that for some types of release sites, the model was unable to predict concentrations as close as the assumed fenceline distance.   In these cases, the exposure estimates were based on the highest concentrations predicted by the model.

EPA documents several areas of uncertainty associated with the release, concentration, and exposure estimates; these are not repeated here.

APPLYING EPA'S EARLIER APPROACH TO THE SNAP RISK SCREENS

For the SNAP risk screens, general population exposures to ambient air releases of ODS substances were estimated using three basic steps:

(1)The first step was to update the ambient air release information presented in the EPA report (EPA 1990) using more recent data. Conservative estimates were made of annual ambient air releases of ODS substitutes from different types of facilities (e.g., chemical manufacturing plants, factories that produce equipment containing the substitutes, sites at which the substitutes are used, service stations, centralized recycling or disposal facilities);

(2)Each type of release site was "matched up" with one that was modeled earlier by EPA; and

(3)The results of the previous ISCLT runs were used to determine the relationship between the release rate and exposure point concentration for each type of release site; that factor was then applied to the revised release estimates to derive a new fenceline concentration.

Steps (1) and (3) were straightforward. The approach used to calculate releases from different types of facilities (Step 1) is described in the section documenting the general population exposure analysis for each use sector. To determine the relationship between releases and fenceline concentrations (Step 3), EPA's contractor for the earlier analysis (Versar) provided a table identifying the "normalized maximum concentration at the fenceline, $\mu g/m^3$" for each of the runs conducted for the interim report. These normalized maximum concentrations, shown in Exhibit 6-A-1, are the maximum fenceline concentrations that result from the release of one gram per second (g/sec) of ODS from a source. Using them is simply a matter of converting estimated annual releases to g/sec and multiplying them by the normalized concentration, yielding maximum fenceline concentrations in $\mu g/m^3$.

Some difficulties were encountered in the second step, however, which add to the uncertainties associated with the ambient air modeling. These difficulties arise from two factors, discussed below.

•First, it was sometimes difficult to identify the type of facility associated with each normalized concentration listed in Exhibit 6-A-1. This is because the normalized concentrations are presented by type of activity (e.g., manufacturing, servicing) rather than type of source (e.g., factory, operating site, service station). To cross-walk the normalized concentrations provided in Exhibit 6-A-1 with different types of release sites for the SNAP risk screens, EPA examined the model input parameters and patterns among the normalized concentrations themselves. EPA believes that the types of release sites associated with each normalized concentration were identified accurately using this approach.

•Second, and more importantly, the SNAP risk screens cover certain end uses that were not covered in the general population exposure portion of the interim analysis because the end uses were believed to consume relatively small amounts of ODSs. Because the SNAP risk screens attempt to cover all end uses, normalized concentrations were needed for source types not previously modeled. Professional judgment was used to select which normalized concentrations (among those listed in Exhibit 6-B-1) to use for source types that were not modeled earlier.

Exhibit 6-B-2 lists the normalized concentrations that EPA used for each source type in the SNAP analyses of general population exposure to ambient air releases.

EXHIBIT 6-B-1
NORMALIZED FENCELINE CONCENTRATIONS (EPA/VERSAR)

SECTOR	ACTIVITY	TYPE OF RELEASE	NORMALIZED MAX. FENCELINE CONC. ($\mu g/m^3$)
CHEMICAL MANU-FACTURING	Manufacture of CFCs	Stack	8.9
	Manufacture of CFCs	Area	60.4
REFRIGERATION	Retail Food: Manuf./Install.	Volume	166.3
	Retail Food: Servicing	Volume	864.8
	CSW: Manuf./Install.	Volume	102.5
	CSW: Servicing	Volume	102.5
	Chillers: Manuf./Install.	Volume	166.3
	Chillers: Servicing	Volume	40.7
	Ice Makers: Manuf.	Volume	166.3
	Ice Makers: Servicing	Volume	864.8
	Ice Skate Rinks: Manuf.	Volume	254.8
	Ice Skate Rinks: Servicing	Volume	254.8
	MACs: Manuf.	Volume	58.8
	MACs: Servicing	Volume	864.8
	Chem. Proc. & Refineries: Manuf.	Area	56.7
	Chem. Proc. & Refin.: Servicing	Area	56.7
FOAM BLOWING	Foam Blowing: Rigid & Flexible	Stack	6.2
	Foam Blowing: Rigid & Flexible	Volume	62.4
SOLVENTS	PC Board Cleaning	Stack	9.6[a]
	PC Board Cleaning	Volume	166.3
	Other Electronics Cleaning	Stack	9.6[a]
	Other Electronics Cleaning	Volume	472.7
	Metal Cleaning	Stack	9.6[a]
	Metal Cleaning	Volume	166.3
STERILIZATION	Sterilization	Volume	40.7

[a] Normalized maximum concentrations for stack releases for the solvents sector were not provided by Versar.   These values were back-calculated based on the releases and fenceline concentrations provided in the earlier EPA reports.

EXHIBIT 6-B-2
NORMALIZED MAXIMUM CONCENTRATIONS (µg/m³) APPLIED TO DIFFERENT TYPES OF RELEASE SITES FOR SNAP RISK SCREENS[a]

SECTOR	END USE	FACTORY RELEASES	OPERATING SITE RELEASES	SERVICE STATION RELEASES	DISPOSAL SITE RE-LEASES[b]
CHEMICAL MANUFACTURE	Manufacture of CFCs	Stack: 8.9 Area: 60.4	NA	NA	NA
REFRIGERATION	Retail Food	166.3	864.8	NA	NA
	CSW	**166.3**	102.5	NA	NA
	Chillers	166.3	40.7	NA	NA
	Ice Makers	166.3	864.8	NA	NA
	Ice Rinks	**166.3**	254.8	NA	NA
	MACs	58.8	NA	864.8	**56.7**
	ChProc & Ref	**166.3**	56.7	NA	NA
	Transport Ref	**166.3**	**864.8**	NA	NA
	Home Appliances	**166.3**	**864.8**	NA	**254.8**
	Commercial A/C	**166.3**	**254.8**	NA	NA
FOAM BLOWING	Flexible Foam	NA	NA	NA	NA
	Other End Uses	**62**	NA	NA	NA
SOLVENT CLEANING	Cleaner Formulation	Stack: **8.9** Area: **60.4**	NA	NA	NA
	PC Board Cleaning	NA	Stack: **9.6** Volume: 166.3	NA	NA
	Other Electron. Cleaning	NA	Stack: **9.6** Volume: 472.7	NA	NA
	Metal Cleaning	NA	Stack: **9.6** Volume: 166.3	NA	NA
STERILIZATION	Sterilization	NA	40.7	NA	NA
AEROSOLS	Propellants	**166.3**	NA	NA	NA
	Solvents	**166.3**	**472.7**	NA	NA
HALONS	Processing and Equipment	**173**	NA	NA	NA
ADHESIVES, COATINGS, AND INKS	All End Uses	**166.3**	**166.3**	NA	NA

[a]Entries in **bold** were developed for the SNAP risk screens based on a review of EPA and Versar documents; those not in bold were taken directly from Versar (see Exhibit 6-A-1).

[b]Applies to cases in which equipment is transported to a centralized location (e.g., recycling center or salvaging yard) before the ODS substitute is removed.

REFERENCES FOR ATTACHMENT 6-B

U.S. EPA.   1990a.   November 7.   *Potential Ambient Inhalation Exposures for Chlorofluorocarbon Substitutes.*   Office of Toxic Substances, Exposure Evaluation Division, Exposure Assessment Branch.

U.S. EPA.   1990b.   November.   *External Review Draft, Hydrofluorocarbons and Hydrochlorofluorocarbons, Interim Report.*   Office of Toxic Substances.

U.S. EPA.   1990c.   *Revised Draft: Occupational Exposure and Environmental Release Data for Chlorofluorocarbons (CFCs) and Their Substitutes.*   Office of Toxic Substances.   April 2, 1990.

U.S. EPA.   1987.   *Industrial Source Complex (ISC) Dispersion Model.   Addendum to the User's Guide.*   U.S. Environmental Protection Agency, Research Triangle Park, NC.

U.S. EPA.   1986.   *Industrial Source Complex (ISC) Dispersion Model User's Guide, Second Edition, Volumes 1 and 2*.   Publication Nos. EPA-450/4-86-005a, and -005b.   U.S. Environmental Protection Agency, Research Triangle Park, NC. (NTIS PB86 234259 and PB86 234267).